Error indicators and adaptive refinement of finite element thin-plate splines

The thin-plate spline is a technique for interpolating and smoothing surface over scattered data in many dimensions. It is a type of polyharmonic splines that appears in various applications, including image processing and correspondence recovery. It has some favourable properties like being insensitive to noise in data. One major limitation of the thin–plate spline is that the resulting system of equations is dense and the size depends on the number of data points, which is impractical for large datasets. A discrete thin–plate spline smoother has been developed to approximate the thin–plate spline with piecewise linear basis functions. The resulting system of equations is sparse and the size depends only on the number of nodes in the finite element grid. However, a solution with high accuracy will still require a fine grid. Adaptive refinement of discretised grids was developed to adapt the precision of the solution within sensitive regions (e.g. peaks, boundaries, singularities, etc.), which can be determined by error indicators. Traditional error indicators might not work for the discrete thin–plate spline smoother as it is using data, which might have irregular distribution and noise. In this talk, I will give a brief introduction of the problem and challenges and present some error indicators for the discrete thin–plate spline smoother.